THERMAL DRYING OF BIOSOLIDS

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ABSTRACT

A thermal biosolid dryer has been installed at the Ballarat North Water Reclamation Plant (BNWRP). The BNWRP was constructed in 2007 and is designed for 8.4ML/d of combined industrial wastewater and domestic sewage. There are no sludge digestion facilities and Waste Activated Sludge (WAS) is discharged direct to a thickening centrifuge which produces a 3% dry solid sludge. Dewatering centrifuges then dewater the sludge to 18% dry solids which is the feed material for the thermal dryer. The dryer uses natural gas as the fuel for a rotating drum kiln. Biosolids are dried from 18% dry solids to 92% dry solids and approximately 80T per month of dry pelletised biosolids are produced for reuse.

KEY WORDS

Biosolids, Centrifuge, CHW, Sludge, Thermal Dryer, WAS

1.0 INTRODUCTION

In June 2006 United Water (UW) were awarded the contract from Central Highlands Water (CHW) to operate the existing Ballarat North Waster Water Plant (BNWRP). UW began running the 50 year old treatment plant which was found to have many short comings, in particular the treatment of the biosolids. While the process worked well the issue of the completed belt pressed digested biosolid was a method that could not continue with the introduction of a new treatment process. This was due to the ongoing labour requirement in the operation of the belt press, the availability of biosolid drying space, the odour issues and the new UW contract requirement that biosolid had to meet the minimum Victorian Environmental Protection Authority (EPA) requirement of T_1C_2 and removed from site within 24 hours of production.

The proposed method of biosolid production and disposal was therefore part of the reason UW was awarded the Design, Build and Operate (DBO) contract for the BNWRP. With UW's conceptual design for a new waste water reclamation plant, UGI carried out the detailed design and began land clearing in September 2006. United Group Infrastructure (UGI) had construction take place over the following 15 months to allow transfer of waste water treatment from the old BNWWP to the new BNWRP in January 2008.

In this paper we will discuss UW's experience in the design, construction, operation and disposal of biosolids using the thermal drying method.

2.0 DESIGN

UGI studied a number of methods to meet the requirements of the contract and found most sewage biosolids in Australia were dewatered mechanically, using belt presses or filter presses.

At Ballarat North it was considered more practical to use a centrifuge to dewater the WAS to minimise the ongoing daily labour requirement and this would be followed by direct Thermal drying of biosolids that were known to offer the following advantages:

- The cooling of hot biosolid results in significant amount of hot water that could either be sent to effluent or be used to increase the bioreactor temperature particularly in winter and so improve performance.
- A much lower volume of biosolid to compared with mechanically dewatered biosolid.
- Pathogen free biosolids to achieve the EPA Treatment Grading of T_1.
- Dry product to minimise objections to recycling.
- Potential to be used in a wide range of areas: agriculture or fertiliser or compost or land cover or fuel for manufacturer of cement or fuel for energy recovery.
- Meet contracted conditions of removing Biosolids from site within 24 hours of production.

The disadvantages associated with thermal drying of biosolids were:

- Risk of fire and explosion due to the presence of gas and dust.
- High ongoing plant maintenance due to abrasiveness of biosolids.

Even though a number of disadvantages were known the direct Thermal Drying of the biosolids was the method chosen for Ballarat North to eliminate the prospect of having dewatered biosolid stockpiled on site as CHW had indicated that this was not the preferred long term option. The direct Thermal Drying process could produce a T_1 grade biosolids suitable for beneficial reuse. In adopting this technology, key considerations were safety, product appeal and availability of reuse for the product.

3.0 CONSTRUCTION

Construction of the new Ballarat North treatment plant began in September 2006 and the biosolid wasting sections were completed by April 2008.

Figure 1: ***Thermal Dryer during construction***

4.0 THE WASTING PROCESS

Collection

Waste collection as designed (Figure 2) was planned to occur throughout the treatment plant. The WAS is removed at a set wasting rate of 1/30th the volume per day of the Biological Reactors. This WAS is thickened through a thickening centrifuge and combined in the sludge blend tank with scum layers from both the primary and secondary clarifiers and combining this with 3 minutes of the fermenter solids every hour.

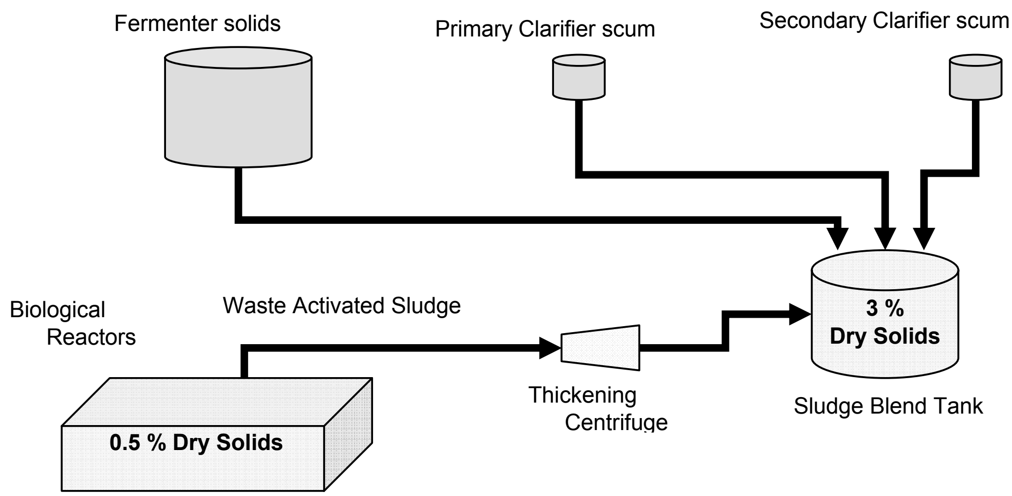


Figure 2: ***Waste Collection System***

Centrifuge

The sludge blend tank is mixed to create a consistent blend for the dewatering centrifuge. The dewatering (Figure 2) occurs as required with one or two centrifuges that dry to 18% and then transfer to the thermal dryer.

Mixing

The thermal dryer combines the 18% wet biosolid with 90% dry biosolid to create a mixture of around 60% dry biosolid. This mixture is combined in a mixer that feeds into a twin screw to ensure complete mixing.

Thermal Drying

The mix is then moved through the feed screw directly into the thermal dryer, which is a gas fired (up to 600 ^{o}C) burner that tumbles the product, to end up producing a 90% dry biosolid product. The 90 ^{o}C biosolid is cooled in a water cooled auger to 40 ^{o}C.

Screening

The product then is mechanically sized in a series of screens, to obtain a consistent product that ensures there is no potential product wet spots. With this consistency the product can meet the EPA treatment grading of T_1. The larger product may still be damp and it is first to be screened out, dropped through to a crusher that reduces the product size and returns back to the recycle hopper to repeat the process. The second screen is of the acceptable size and was verified in commissioning to meet the desired minimum 90% dryness. The third screen is for the particles which are smaller than the desired range. This is generally the dust or broken beads caused during the transfer in the augers.

Dust is kept separate to good product to eliminate concerns of having dust at the disposal points. The product is returned back to the recycle hopper to repeat the process.

Onsite Disposal
The acceptable product is transferred into waiting skip bins, which are trucked out.

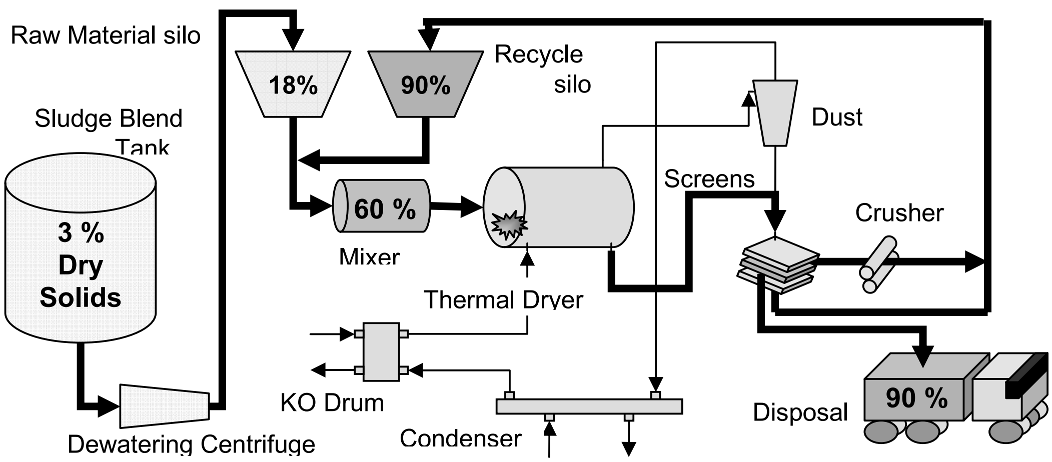


Figure 3: ***Wasting Process***

Biosolid Quality Sampling
To have consistent operation of the thermal dryer, operators have performed weekly onsite tests of the solids entering the thermal dryer. Output of the thermal dryer has been electronically controlled to ensure a minimum level 90% dry solids and this is confirmed by 3rd party NATA approved laboratories. The T_1C_2 will be monitored with 3 monthly sampling by a 3rd party NATA approved laboratory.

4.1 Continuous Improvement

Continuous improvement has occurred through out the commissioning and running of thermal drying system over the last 15 months as the operators gained experience with the equipment and process.

Mechanical equipment
The thermal dryer is a single sludge processing train therefore the mechanical equipment needs to be reliable and appropriate spares held to allow for speedy replacement. In our case the Ballarat North biosolids have proven to be abrasive, causing continuing issues with the infeed screw and the cooling water jacket on the discharge conveyor, both of which have been repaired 3 times in 15 months. The cooling water jacket on the infeed screw has also been replaced once due to excessive corrosion caused by the potable water reacting with the mild steel cooling water jacket.

Electrical equipment
Numerous electrical issues have occurred largely due to faulty Programmable Logic Controller (PLC) parts together with a number of items not necessarily suited to the requirements of the job. More suitable equipment has been installed and now we have minimal concerns.

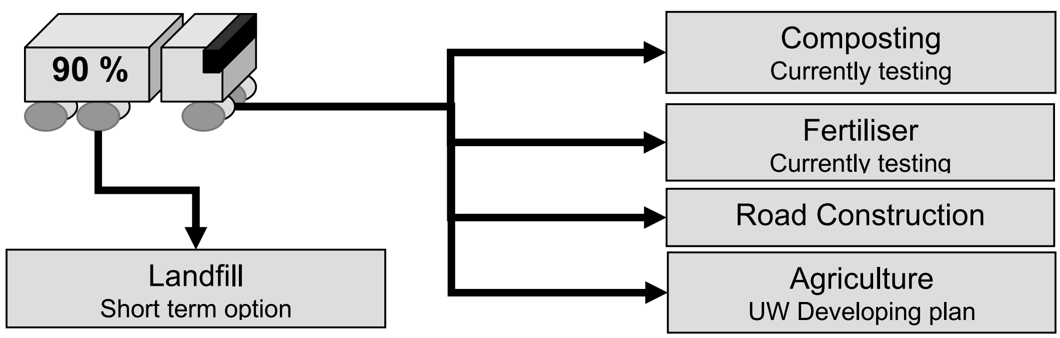
Contingencies

There have been many forced shutdowns to our thermal dryer but with experience we are reducing downtime. The Ballarat North contingency for when the dryer is not operating is to retain sludge within the Biological Reactors or removing dewatered biosolids off-site We have found emptying the Thermal Dryer raw material hopper by transferring wet biosolid into skips eliminates the issue of dry biosolids moving throughout the thermal dryer on start up which can cause lengthy delays in getting the equipment back to stable operation.

Ongoing preventative maintenance occurs on the Monday of each week. Preventative maintenance programs have been created to improve reliability and critical spares are held on-site.

5.0 BIOSOLID DISPOSAL

Following the design of the Thermal Dryer which produced 92% dry solids at a treatment grading of T_1C_2 United Water sourced a reuse composting candidate who would receive the product that would be delivered in $10m^3$ sealed spirotainers then process to EPA requirements. This operation is winding down and United Water has since organised to have the product delivered to landfill while other reuse options have been investigated for continuing supply. As per Figure 4, Disposal Options under investigation include:



<u>**Figure 4:**</u> ***Disposal Options***

6.0 CONCLUSION

UW has begun to show that the method of thermally drying biosolids is a method which will continue to improve with time as equipment fine tuning and operator experience improves. Currently Ballarat North has not experienced any safety issues concerning the operation. The end product of 90% dry biosolid has met the official Victorian EPA classification of T_1C_2 which allows reuse operators confidence they have a safe product.

7.0 REFERENCES

EPA Victoria *"Guidelines for Environmental Management – Biosolids land application"* Publication 943, 2006, pg 11-14, 15

This report can be downloaded from the EPA publications website:
http://epanote2.epa.vic.gov.au/EPA/publications.nsf/PubDocsLU/943?OpenDocument